IJET

Original Paper

Journal homepage: http://educationaltechnology.net/ijet/

OPEN ACCESS

Higher education students' ownership and usage of smart phones and tablets: the case of Kwame Nkrumah University of Science and Technology (KNUST)

Harry Barton Essel*,a, Francis Kofi Nimo Nunoob, Akosua Tachie-Mensona, John Opuni Amankwaa

aDepartment of Educational Innovations in Science and Technology, Kwame Nkrumah University of Science and Technology, Ghana

bDepartment of Publishing Studies, Kwame Nkrumah University of Science and Technology, Ghana

KEYWORDS	ABSTRACT
Smartphones Tablets Digital technologies Elearning	There are variable levels of ownership and usage of digital technologies among students in KNUST which can affect curricula implementation and integration. This study focused on ownership and usage of smartphones and tablets. A sample of 183 students was used for the study. Results showed that students owned various types and brands of mobile devices with smartphones recording the highest ownership levels. Android OS was most used on the devices identified. These devices were used mainly for "edutainment". Irregular internet speed, erratic power supply and high cost of internet data are challenges faced by students in their use of these digital devices.

Introduction

Technology affects practically every facet of our lives these days. New digital technologies have virtually taken over activities in economy markets, politics, the way people communicate, home activities as well as the operations of all levels of education (Guri-Rosenblit, 2009). The experimental use of technology for teaching and learning in schools, colleges and universities became popular in the 1980s (Haßler, Major & Hennessy, 2016). And now these technological innovations are altering the way universities teach, and students' approaches to learning, as "no generation is more at ease with online, collaborative technologies than today's young people – 'digital natives', who have grown up in an immersive computing environment" (The Economist, 2008).

With the adoption of mobile technologies in education, studies now show the value of integrating such devices into the teaching and learning environment (McFarlane, Triggs & Yee, 2008; Traxler & Wishart, 2011). The consistent increase in access to wireless Internet around the globe, and particularly within tertiary institutions (Nunoo & Anane-Antwi, 2014), has resulted in the prevalent adoption of mobile technologies in education (Hwang & Tsai, 2011; Hwang & Chang, 2011; Martin & Ertzberger, 2013).

* *Corresponding author.* E-mail address: bartoness@gmail.com

Advances in technologies in the mobile industry have resulted in the development of a wide range of mobile operating systems with the three dominating players being Google Android, the Apple iOS and Microsoft Windows Phone (Ally & Gardiner, 2012). Different mobile devices such as smartphones and tablets, are being used in educational circles (Traxler, 2010; Kearney et al., 2012), which can now run feature-rich apps provided by Apple, Google, and Research In Motion, the three leading app stores. Apple reported an estimated 140 billion apps as being downloaded from its store from July 2008 to September 2016, and from Google's Play store, an estimated 65 billion as at May 2016 (Statista, 2016). The recent paroxysms of mobile apps have created a new market for academic apps that focus specifically on enhancing teaching and learning experience. Educational apps were among the most popular type of downloads, after gaming, books, and entertainment (Walker, 2011) but by the end of 2014, Educational apps were ranked second of all downloads from app stores, surpassing both entertainment and business apps in popularity (Homes, 2014).

The use of smartphones, tablets and other technologies are abating the concept that knowledge ends with the individual and dwells within specific physical spaces (brick and mortar system of education), driving home the mobile and ubiquitous nature of education (Martin & Ertzberger, 2013; Sevillano-Garcí & Vázquez-Cano, 2015). Mobile devices and apps offer advanced computing capabilities as well as access to internet-based resources (Murphy, Farley, & Koronios, 2013), and are mostly equipped with the hitherto traditionally desktop functions such as portable media player, GPS navigation, digital camera and eBook readers (Ally & Gardiner, 2012). They allow users not only to consume, but also discover, produce and share content (Chen & Denoyelles, 2013), thereby transforming and influencing students' learning experiences. The use of these new technologies has indeed changed the speed of production and distribution of knowledge (Guri-Rosenblit, 2009).

Again, the widespread ownership of digital devices and the increasing availability of other portable and wireless devices have been changing the landscape of technology-supported learning, and these technologies turn out to be well aligned with overall strategic educational goals such as improving students' retention and achievement, and supporting differentiation of learning needs (Hashemi, Azizinezhad, Najafi & Nesari, 2011).

These digital devices can further be integrated into student learning in higher education, to support communication between learners and their instructors, when used in file sharing mechanisms, as discussion media or platforms, as well as for information search. As an instructional tool, a digital device can also be used by instructors to give learners e-books, educational content, and other learning materials and as an assessment tool to evaluate student learning activities (Shonola, Joy, Oyelere & Suhonen, 2016).

In short, Homes (2014) explains:

> *It is so easy for students to carry tablets [smartphones] from class to class, using them to seamlessly access textbooks and other course materials as needed, that schools and universities are rethinking the need for computer labs or even personal laptops. A student's choice of apps makes it easy to build a personalized learning environment, with all the resources and tools they need on a single device. With their growing number of features, tablets give traction to other educational technologies — from facilitating the real-time data mining needed to support learning analytics, to offering a plethora of game-based learning apps.*

Geographically, the popularity of mobile technologies within higher education is growing rapidly especially in developed economies (Chen & Denoyelles, 2013). In their study, Chen and Denoyelles reported laptops (85%) as the most important device to students' academic success, with rises in tablets (45%) and smartphones (37%). In furtherance, they opined that "Increasingly, students say they want the ability to access academic resources on their mobile devices" and thereby establishing that "67 percent of students' smartphones and tablets are reportedly being used for academic purposes."

In other to survive in the 21st century ecosystem, a specific attention is given to training that equips students with the knowledge to make decisions on what devices and technological processes to use in solving problems, and achieving a better learning experience (Sevillano-García & Vázquez-Cano, 2015).

Despite the wider benefits associated with the use of these devices necessitating their adaptation in many educational environments (Haßler et al., 2016), most institutions tend to flinch at the cost of providing mobile hardware for their students (Farley et al., 2015; Crompton, 2013), leading to the consideration of the practice of 'bring your own device' (BYOD), where students bring their own digital devices – leaning towards small and portable ones such as smartphones and tablets.

> *Emphatically, although many students own mobile devices, ownership is not universal. Identifying specific student demographics that might relate to ownership trends is thus critical. It is also important to determine which devices are most helpful for academic use; mobile technologies afford new opportunities for learning, but their use does not guarantee that effective learning will take place (Chen & Denoyelles, 2013, para 7).*

KNUST in its corporate Strategic Plan 2016-2025 (Planning Unit, KNUST, March, 2016:42) has stressed the importance of ICT in education and the willingness to incorporate it into the teaching and learning environment of its campuses by embarking on vigorous ICT infrastructural projects such as extending internet connectivity to various lecture halls, theatres and halls of residences, and the provision of computers at various labs and libraries. In spite of the University's effort to provide all the needed ICT infrastructure, the growing student population could put pressure on such facilities and the

way forward would probably lean towards the concept of "Bring Your Own Device (BYOD)". Though the concept of BYOD is imminent, there is little or no empirical studies to establish students' access to digital devices and how they are using them in their everyday activities in Kwame Nkrumah University of Science and Technology. Hence, the study investigates students' ownership and usage of the smartphone and tablets, and how they are influencing their learning experiences in the university.

Review of related literature

Studies on the use of mobile devices in higher education is widespread. Nguyen, Barton and Nguyen (2015) in their content analysis of articles from EBSCOhost, Scopus, Informit A+ Education and Google scholar showed that studies on the use of these digital devices in higher learning are at their exploratory stages. Their work found that students were enthusiastic with the adaptation of these technologies since they enhanced their learning experience, but showed no evidence that it necessarily would lead to better learning outcomes. They opined that in spite of the benefits, academic institutions and students are not clear as to how best to align and integrate these technologies into their academic programs and workflows, as well as how best to manage these as resources within the institutions' organizational setting.

Gerard, Knott and Lederman (2012) explored the instructional use of tablet technology in active learning using Meyers and Jones' (1993) framework. They posited that tablet technologies can support and enhance active learning strategies, stating that tablets can be used in course discussions, simulations and small group collaborations in both in and out-classroom environments.

Farley et al (2015) reported on student ownership of mobile devices at a regional Australian university explaining that students do have access to, and use a wide range of devices but are bedevilled with challenges such as lack of optimization of course materials for use on smartphones, scrolling difficulties with navigating websites, and learning management systems. Their major concern was the lack of students' participation in any educator-led mobile learning initiatives.

In the opinion of Percival and Claydon (2015), the use of tablets for teaching and learning should be encouraged, to equip students for the work environment in the 21st century. They argued that for that to be successful, "both students and faculty need additional training and support." In spite of the advantages with the use of tablets, they acknowledged that the state of tablet devices in present times could not handle all the complex computation needs – word processing, data analysis and presentational tools – of users, but could serve as an augmentation and expansion to connectivity and computing choices aimed at increasing connectivity and social interaction, through improved applications and interface.

Shonola, Joy, Oyelere and Suhonen (2016), assessing students' use of mobiles devices for m-learning in higher education in Nigeria, noted that students are not only willing to use their mobile devices –smartphones, tablets, etc. – to augment classroom lectures, but also to achieve the globalization objective of digital citizenship.

Sevillano-García & Vázquez-Cano (2015) studied the adaptation of digital mobile devices within three Spanish public universities and concluded that with the high penetration of these devices among college students, their use is improving several indicators of generic competencies, especially those of "self-regulated learning," "higher cognitive," "communication," "instrumental in the knowledge society," and "interpersonal" relationships.

Methodology

This is a baseline study. The Food and Agricultural Organization (FAO) corporate document repository (2016) defines a baseline study as a descriptive cross-sectional survey that provides quantitative information on the current status of a particular situation in a given population. It aims at quantifying the distribution of certain variables in a study population at one point in time and it involves the systematic collection and presentation of data to give a clear picture of a particular situation as it relates the following: What? Who? Where? When? Why? How? This study aimed to identify the kind of digital mobile devices (smartphones and tablets) KNUST students have and what they use them for.

A sample size of 370 were expected for the study from the sample population of over 10000 undergraduate students. The sample size chosen was based on calculation from Krejcie and Morgan's (1970) Determining Sample of a Known Population table (The Research Advisors, 2006). For ethical reasons, respondents were not obliged to participate in the survey and did that on their own will. The survey was conducted within a period of three weeks.

The research Instrument

A quantitative online survey was used for the study. Nulty (2008) explains that the use of web-based questionnaires helps in bypassing many of the bottlenecks in the evaluation system (e.g. data entry and administration), to a more "just in time" evaluation model A survey questionnaire was designed using Google Form and a short url (link) was generated. In deploying the questionnaire, individual class "WhatsApp" group platforms within the University were used. Contacts of various "Class WhatsApp group" administrators were collected and a link to the questionnaire was posted to them. The administrators in turn posted the link to their various class platforms. This method was chosen to give every student the chance to participate in the survey. The survey consisted of three sections: (1) student demographics, (2) devices ownership and (3) the usage of the devices. The survey data were collected from the 7th to the 27th of November 2016.

Survey participants

A final sample of students (n=183) participated in the survey representing 49.45% of the expected sample population. A 30% response rate from an online survey is considered average for analysis according to Hamilton (2003). Out of the total sample respondents, 60.7% were males and 39.3% were females. The respondents numbering about 41% (75) were in Year 4 of which majority (56%) were males. Of the 39.3% of females respondent (72), 13.9% were in Year 1, 19.4% in Year 2, 20.8% in Year 3 and 44% in Year 4. The age ranges recorded in the study were 27.3% for 16-20 years, 69.9% for 21-25 years, 2.2% for 26-30 years, and 0.5% for 36 years and above. Only 2.2% of respondents within the age range of 16-20 years were in final year. The mean age of the respondents was 22.18.

Results

Ownership of smart devices by higher education students

The first objective of the study was to ascertain the ownership levels of digital devices (smartphones and tablets) within the student population. From the data analyzed, 84.7% of the respondents owned smartphones and 15.3% had tablets. It must be emphasized that some of the respondents owned more than a single smart device. Details of the results in shown in table 1.

The survey also sought to find out the most common brands of smart devices and types of operating systems (OSs) that ran on these smart devices. This served as a basic knowledge to ascertain OSs commonly used by students, in order to inform and facilitate future creation and deployment of academic apps designed by the University Information Technology (IT) Centre. The results on the various brands of smart devices and the types of operating systems running on them are displayed in table 2.

Table 1

Smart devices owned by students

Type of device owned	Freq.	Percent
Smartphone only	148	80.87
Two smartphones	3	1.64
A smartphone and a tablet	23	12.57
Tablet	9	4.92
Total	183	

Table 2

Brands and operating systems of smartphones

Brand	Operating System						
	Android		Apple (iOS)		Windows		
	Smartphone	Tablet	Smartphone	Tablet	Smartphone	Tablet	Total Devices
Samsung	76	13	-	-	-	-	89
Infinix	28	-	-	-	-	-	28
Tecno	6	1	-	-	-	-	7
itel	4	8	-	-	-	-	12
LG	7	-	-	-	-	-	7
HTC	5	-		-	-	-	5
Apple	-	-	43	9	-	-	52
Microsoft	-	-	-	-	7	2	9
Total	126	22	43	9	7	2	209

Table 2 shows that smart devices used by majority (70.81%) of the students sampled run on Android. 24.88% of devices run on Apple's iOS with windows operating system (4.30%) being the least. Of the total 148 android devices recorded spanning six brands, Samsung was the preferred brand. Of the 209 devices recorded during the study, 33 were tablets and 176 smartphones. The gender ratio distribution of tablet ownership was 33.3% females to 63.6% males.

Regarding the question of ways of acquisition, many of the respondents either bought their devices themselves (44.3%) or by their parents (45.9%). Only 9.8% were given as gifts from friends. From the data analyzed, it is evident that between the ages of 21 and 25, most students showed signs of slight self-sufficiency (48.1%). In the same age bracket, some (28.6%) are mostly dependent on their parents. The marginal dependency ratio on parents tilted towards the females (31.0%) than the males (25.0%) as shown in table 3.

Table 3

Mode of acquisition of digital devices (Smartphones and Tablets)

Age range	Gender		purchased by parents (%)	purchased by friend (%)	purchased by myself (%)	Total
			How did you get the device			Total
	Female		20	3	2	25
			(40.0)	(6.0)	(4.0)	(50.0)
	Male		16	0	9	25
			(32.0)	-	(18.0)	(50.0)
	Total		36	3	11	50
			(72.0)	(6.0)	(22.0)	(100.0)
21-25 years	Female		26	6	14	46
			(20.3)	(4.7)	(10.9)	(35.9)
	Male		21	8	53	82
		1	(16.4)	(6.3)	(41.4)	(64.1)
	Total		47	14	67	128
			36.7	10.9	52.3	100.0
26-30 years	Female		1	0	0	1
			25.0	0.0	0.0	25.0
	Male		0	1	2	3
			-	25.0	50.0	75.0
	Total	Count	1	1	2	4
		Total	25.00	25.00	50.00	100.00
36 years and above	Male				1	1
		% of Total			100.0	100.0
	Total				1	1
					100.0%	100.0%
Total	Female		47	9	16	72
			25.7	4.9	8.7	39.3
	Male		37	9	65	111
			20.2	4.9	35.5	60.7
	Total		84	18	81	183
			45.9%	9.8%	44.3	100.0

Usage for devices

To understand how students used their digital devices and for what purposes, respondents were asked to select from a list, activities that they were likely to undertake (Murphy, Farley, Lane, Hafeez-Baig & Carter, 2014). This was provided as a matrix question and students could choose as many options as applicable; this question was applicable to both smartphones and tablets.

The general responses in relation to what they use their smartphones for are as follows: 73.2% of the respondents use their devices for research purposes; 51.9% use their smartphones for checking class assignments; 25.7% use their devices to take notes or record lectures; 60.7% read digital books format such as pdf and Epubs, and do online banking activities on their smartphones; 45.9% use their smartphones for checking class schedules; 63.9% for sending and receiving Short Message Service (SMS); 65% of the students used their smartphones for listening to music and a minority 20.8% watched movies on their devices.

In terms of the use of social media apps, majority (79.8%) of respondents were active on WhatsApp, 57.4% on Facebook, Instagram (54.6%) and video streaming (tutorials) from YouTube and other video sharing platforms (45.9%). The use of Twitter had low participation (24.6%). Out of the total 134 respondents who used their smartphones for research purposes, 70.1% of them were between the ages of 21-25 years of which 46.2% were males and 23.9% females. Of the remaining respondents, 29.1% were between 16-20 years and the 0.7% were above 25 years. The analyzed data showed final years
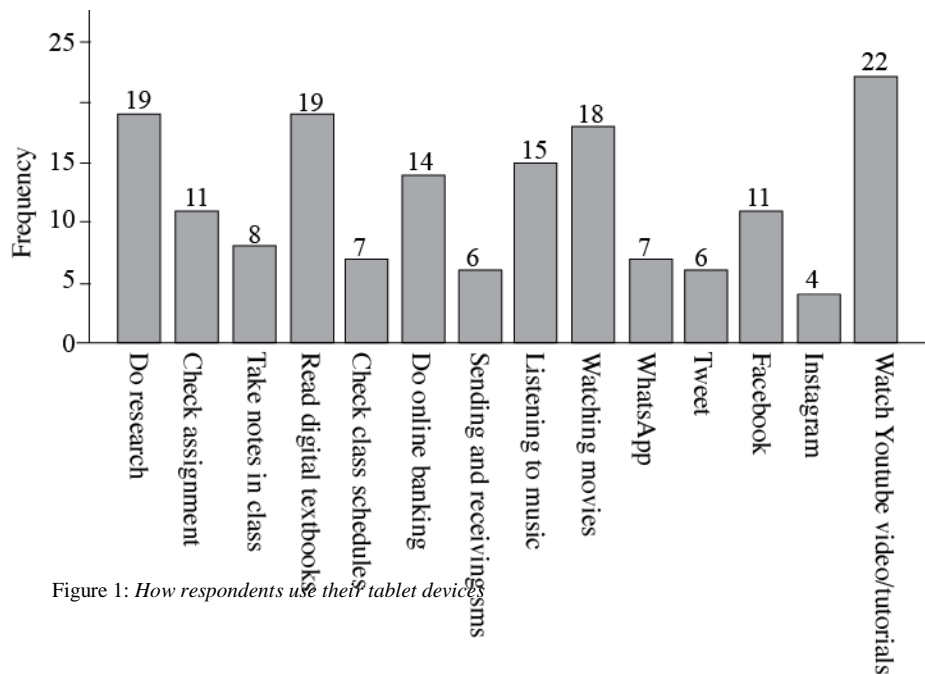
Figure 1: *How respondents use their tablet devices*

(level 400) were in the majority of respondents (43.3%) who used their smartphones for research and follows in a descending order according to the academic levels.

Results on the use of tablets is shown in figure 1. Watching of videos, reading from the tablet and doing research ranged higher among respondents in the use of these devices. It must be emphasized that none of the respondents that used Apple tablet could use WhatsApp – a social media app since the operating system does not support it.

As regards challenges students faced using these devices and related services, the study outlined some of issues that have been highlighted in the related literature and respondents were at liberty to select as many options as applicable. The tabulation of their responses is shown in figure 2. Even though the University provides students with some 2 gigabytes of data per month and has Wi-Fi signals installed all over campus, students still have challenges with the inadequacy of data to perform various activities in the quest of their learning. They complain bitterly about the cost of internet data charged by "Telcos" in Ghana. An average of 35 Ghana cedis ($8.75, based on exchange rate of GHC 4 to a dollar) is spent on data of 2 to 2.5 gigabyte per month. Mostly data purchased is not extendable beyond the month of purchase. Issues of bandwidth was expressed as one of the major challenges; due to the large student population and the limited bandwidth assigned to them, streaming and sometimes connectivity through Wi-Fi becomes difficulty.
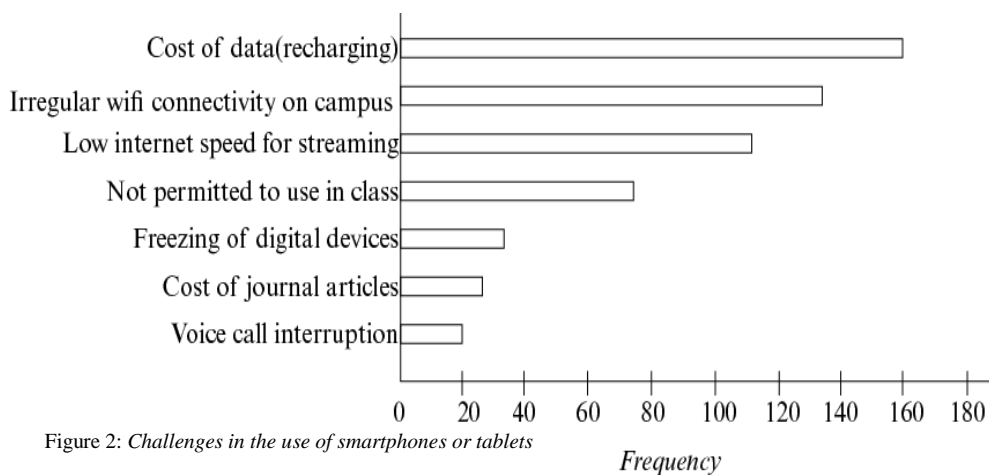

Figure 2: *Challenges in the use of smartphones or tablets*

Students were finally asked of their opinion as to whether digital devices should be allowed to be used synchronously as lectures go on. A total of 182 responded to this question. Of the total responses, 50% were in support of being allowed officially to use their devices during lectures explaining that it would help in researching on issues being discussed in class. 21.4% rejected the idea outright because they deemed the use of it in class as a distraction and that there was no guarantee that students would focus their usage fully on relevant academic work, rather than social media activities. The remaining 28.6% of respondents were not sure as whether or not they should be allowed usage in the classroom. From the gender perspective, majority of the male respondents (68.1%) and females (40.8%) significantly supported the notion of being allowed to use their devices in class even though many of the females were not.

Respondents were asked how long they had been using their mobile devices. Of the responses, 46.4 % had used their devices for more than a year, with 27.3% having used their devices less than or within the last six months. 26.2 % responded they had used their devices for more than six months to a year. For those who had used their devices for more than a year, 30.6% were between 21-25 years, 13.7% between the ages of 16-20 years and 2.1% about

twenty-six years. Out of the 27.3% who had used their devices less than or within the last six months, 20.8% were between the age range of 21-25 years, 6% were ages between 16-20 years and 0.5% over 26 years.

Discussion

Availability and affordability

This study has revealed that many students on KNUST campus own one digital device or the other. However, majority of them have smartphones as evidenced in other studies across the globe (Murphy, Farley, & Koronios, 2013; Porter et al., 2016) compared to tablets (Poll, 2015; Murphy, Farley & Koronios, 2013). The rate of tablet usage is on the lower side, compared to other studies (Farley et al., 2015). This could probably be as a result of cost. The cost of a higher performing tablet is more than that of a smartphone. A small number of the students own more than one device. Such student either have 2 smartphones or a smartphone and a tablet. The study also showed students within age group between 21 – 25 years predominantly use or have access to digital devices with majority running on Android platform; the Android platform was thus the predominant operation system in use. Preference for this platform by the respondents could be attributed to their availability and cost of the devices on the Ghanaian market, as well as the freemiums of its apps from the app stores.

Majority of the students were using devices that cost between 300 and 599 Ghana cedis. The study showed that many parents were willing to buy these digital devices for their wards who were under the ages of 21 years. Of those above 21 years, parents were more likely to buy for their female wards compared with the males.

Uses for devices

Majority of respondents were using their devices for academic research probably because of the academic environment they found themselves in. Many of them always spent some time using their devices for "edutainment" purposes, either listening to tutorials or watching items from YouTube channels. Regarding the use of social media apps, WhatsApp was trending among the respondents (male and females), followed by Facebook. This usage of WhatsApp could partly be due to that fact that many lecturers and course groups are using them as back channelling tools for in- and out-of-class communication, paving way for collaboration between Faculty and students on KNUST campus. The extent of use can be attested to with how data for this study was collected within the study period.

Challenges in the use of these devices

Cost of internet data is a major issue in many developing countries (Nunoo & Anane-Antwi, 2014) and that seems to be the major stumbling block to the effective use of these digital devices by students on KNUST camps. Even though the respondents stated that the institution provides 2 gigabytes of data to every student monthly, that was not enough and the cost of getting extra data for academics was too high for their pockets. Although the University has spent sizable resources in improving its IT Infrastructural facility, the internet speed provided for use by students for academic works is very low and erratic, making it undependable. The erratic power supply on campus was also considered one of the main obstacles in the use of these devices on campus. Students complained that they could not recharge their devices when the cells ran out; and to some, the unstable nature of power supply was causing the destruction of the devices during charging. Their inability to use smartphones and tablets in class was also a major concern to students. Although, some lecturers allow the use of these devices in lecture halls, there is no official policy regarding its permissiveness and as a result, according to the respondents, many lecturers do not allow their use. This, to the respondents, sometimes hinders academic work.

Conclusion

The use of digital devices such as smartphones and tablets is now common among students of KNUST as with those elsewhere in the world (Murphy et al., 2013; Porter et al., 2016). From the study, it is evident that students on campus own various types of these devices and are using them for various activities that holistically speaking, support their learning experience. In spite of the uptake of these devices, tablet ownership is lower compared to smartphones. Issues of connectivity, data cost and internet speed should be looked at and permanent solutions found to improve the use of these mobile devices on campus. On issues of policy regarding allowing the use of these mobile devices in the lecture rooms, it would be appropriate to find out the perception of students and tutors in the incorporation of these technologies in the existing teaching and learning methods, and to explore the possibility of adoption and implementation of Bring Your Own Device (BYOD) in KNUST to facilitate effective teaching and learning in the 21st century.

REFERENCES

Ally, M. & Gardiner, M. (2012). Application and device characteristics as drivers for Smart Mobile Device adoption and productivity. *International Journal of Organisational Behaviour, 17*(4), 35-47.

Chen, B. & Denoyelles, A. (2013). Exploring students' mobile learning practices in higher education. *Educause Review, 48*(5).

Crompton, H. (2013). The benefits and challenges of mobile learning. *Learning & Leading with Technology, 41*(2), 38-39.

FAO corporate Document Repository. (2016, December 05). *CHAPTER 5 Baseline Study in PRCA.* Retrieved December 0, 2016, from http://www.fao.org/docrep/008/y5793e/y5793e07.htm: http://www.fao.org/docrep/008/y5793e/y5793e07.htm

Farley, H., Murphy, A., Johnson, C., Carter, B., Lane, M., Midgley, W., Koronios, A. (2015). How do students use their mobile devices to support learning? A case study from an Australian Regional University. *Journal of Interactive Media in Education, 1*(14), 1-13. DOI:http://dx.doi.org/10.5334/jime.ar

Gerard, J.G., Knott, M.J., & Lederman, R.E. (2012). Three examples using tablet technology in an active learning classroom: Strategies for active learning course design using tablet technology. *Global Education Journal, 4*, 91-114.

Guri-Rosenblit, S. (2009). *Digital technologies in higher education.* New York: Nova Science Publishers.

Hamilton, M.B. (2003). *Online survey response rates and times: Background and guidance for industry.* Cambridge, MA: Tercent Inc.

Hashemi, M., Azizinezhad, M., Najafi, V., & Nesari, A. (2011). What is mobile learning? Challenges and capabilities. *Procedia-Social and Behavioral Sciences, 30*, 2477-2481.

Haßler, B., Major, L., & Hennessy, S. (2016). Tablet use in schools: A critical review of the evidence for learning outcomes. *Journal of Computer Assisted Learning, 32*(2), 139-156.

Homes, J. (2014, December 5). *Tech 2.0 Education & Knowledge Resources.* Retrieved December 11, 2016, from https://www.ibm.com: https://www.ibm.com/developerworks/community/blogs/82288880-044e-425b-8c33-eff85a81d066/entry/10-emerging-technologies?lang=en

Hwang, G.J., & Chang, H.F. (2011). A formative assessment-based mobile learning approach to improving the learning attitudes and achievements of students. *Computers & Education, 56*, 1023-1031.

Hwang, G.J., & Tsai, C.C. (2011). Research trends in mobile and ubiquitous learning: a review of publications in selected journals from 2001 to 2010. *British Journal of Educational Technology, 42*(4), 65-70.

Martin, F. & Ertzberger, J. (2013). Here and now mobile learning: An experimental study on the use of mobile technology. *Computers & Education, 68*, 76-85.

McFarlane, A., Triggs, P., & Yee, W. (2008, April-December). *Researching mobile learning-interim report to Becta.* BECTA. UK: British Educational Communications and Technology Agency (BECTA). Retrieved December 2, 2016

Murphy, A., Farley, H., & Koronios, A. (2013). Understanding the use of smart mobile technologies for learning in higher education. *Proceedings of the 30th Australasian Society for Computers in Learning in Tertiary Education Conference (ASCILITE 2013)* (pp. 602-606). Macquarie University.

Murphy, A., Farley, H., Lane, M., Hafeez-Baig, A., & Carter, B. (2014). Mobile learning anytime, anywhere: What are our students doing. *Australasian Journal of Information Systems, 18*(2), 331-345.

Nguyen, L., Barton, S. M. and Nguyen, L. T. (2015), iPads in higher education—Hype and hope. *British Journal of Educational Technology*, 46: 190–203. DOI: 10.1111/bjet.12137

Nulty, D.D. (2008, June). The adequacy of response rates to online and paper surveys: what can be done? *Assessment & Evaluation in Higher Education, 33*(3), 301-314.

Nunoo, F. K. & Anane-Antwi, E. (2014). The Era of electronic scholarly publishing: Do we stand to benefit in Africa? *CASS Journal of Art and Humanities, 3*(1), 89-102.

Percival, J. & Claydon, T. (2015). A Study of student and instructor perceptions of tablet PCs in higher education contexts. *Higher Education in Transformation Conference.* Dublin, Ireland: ARROW@DIT.

Planning Unit, KNUST. (March, 2016). *Corporate Strategic Plan 2016-2025.* Kumasi: University Press.

Poll, H. (2015). *Pearson Student Mobile Devices Survey 2015.* Pearson.

Porter, G., Hampshire, K., Milner, J., Munthali, A., Robson, E., Lannoy, A., ... & Abane, A. (2016). Mobile phones and education in sub-Saharan Africa: From youth practice to public policy. *Journal of International Development*, 28(1), 22-39. DOI: 10.1002/jid.3116

Sevillano-García, M. L., & Vázquez-Cano, E. (2015). The Impact of digital mobile devices in higher education. *Educational Technology & Society, 18*(1), 106-118.

Shonola, S.A., Joy, M.S., Oyelere, S.S., & Suhonen, J. (2016). The impact of mobile devices for learning in higher education institutions: Nigerian universities case study. *International Journal of Modern Education and Computer Science, 8*, 43-50.

Statista. (2016, December 4). *Statistics and Market Data on Mobile Internet & Apps.* Retrieved December 4, 2016, from The Statistics PortalStatistics and Studies from more than 18,000 Sources: https://www.statista.com/statistics/281106/number-of-android-app-downloads-from-google-play/

The Economist. (2008). *The future of higher education: How technology will shape learning.* Economist Intelligence Unit. Economist Intelligence Unit.

The Research Advisors. (2006). *Sample size table.* Retrieved December 5, 2016, from The Research Advisor: http://research-advisors.com/tools/SampleSize.htm

Traxler, J. (2010). Students and mobile devices. *ALT-J. Research in Learning Technology, 18*(2), 149-160.

Traxler, J. & Wishart, J. (2011). *Making mobile learning work: case studies of practice.* Bristol: ESCalate, HEA Subject Centre for Education, University of Bristol.

Walker, H. (2011). Evaluating the effectiveness of apps for mobile devices. *Journal of Special Education Technology, 26*(4), 59-63.